VOLUME XV NUMBERS 7-8 WHOLE NUMBER 115

THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY
OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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PUBLISHED MONTHLY
(Ten numbers per year)

September-October, 1921

PRINTED FOR THE SOCIETY
TORONTO: 198 COLLEGE ST.

FOREIGN AGENTS: WHELDON & WESLEY LTD.
38 GT. QUEEN ST., KINGSWAY, LONDON

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On account of the high cost of printing, added to the difficulty in getting it done on time, the September and October numbers are issued as a single one. While the expense of printing has increased greatly, the funds available for it are practically the same as some years ago. The addition of many new members to the Society would assist the publication.

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$2.00 per annum. Single numbers, 25 cents.

Subscription to the JOURNAL is included in membership fee.

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VOL. XV SEPTEMBER-OCTOBER, 1921 NOS. 7-8

SHERBURNE WESLEY BURNHAM, 1838-1921

BY EDWIN B. FROST, IN *Science*

We record, with deep regret at his passing, but with high appreciation of his long and valuable service to astronomical science, the death of Sherburne Wesley Burnham, *emeritus* professor of practical astronomy at the Yerkes Observatory of the University of Chicago.

Born on December 12, 1838, in the upper valley of the Connecticut, at Thetford, Vermont, Mr. Burnham had the ordinary advantages of the district school, supplemented by some study in the local academy, but he did not go to college. He became an expert stenographer and shorthand reporter, long before the days of the typewriter, and this was his profession for some thirty years. During the Civil War he served in his professional capacity with the Union Army while it was occupying the city of New Orleans. He came to Chicago, after the close of the war, and became attached to the United States Courts.

His interest in astronomy must have developed very early in the sixties, for he purchased his first telescope during a visit to London in 1861, and in 1870 he became the possessor of a fine six-inch refractor, a masterpiece of Alvan Clark, which he had ordered in 1869. Mr. Burnham's vision was extraordinarily keen, for among the 451 new double stars which he discovered with that

instrument many were found by other observers to be extremely difficult to resolve with much larger instruments.

In 1873 and 1874 he sent five lists of new double stars to the Royal Astronomical Society, which were published in the *Monthly Notices*. At first he had no micrometer and was obliged to give estimated angles and distances. A correspondence developed with Baron Ercole Dembowski, who gladly made the micrometric measurements, with his excellent skill, using a refractor of 162 mm. aperture at Gallarate, in Italy. Two lists covering 136 new double stars were printed in the *Astronomische Nachrichten* in 1875 and 1876. A short list followed in the *American Journal of Science* in 1877 and in *Monthly Notices* for the same year. In 1879 his new doubles from Nos. 483 to 733 were published in the forty-fourth volume of the *Memoirs* of the Royal Astronomical Society, together with micrometric measures of 250 other stars.

During the years from 1877 to 1881 and 1882 to 1884 Mr. Burnham had the use of the splendid 18½ inch Clark refractor of the Dearborn Observatory, then set up in the tower attached to the old Chicago University.

In 1879 he was requested by the trustees of the Lick Trust to test the conditions on Mt. Hamilton. He took his 6-inch refractor, now equipped with circles and a driving clock, to Mt. Hamilton and made observations from August 17 to October 16. His highly favourable report settled the choice of Mt. Hamilton as the site for the Lick Observatory. In 1881 he went again to Mt. Hamilton, by request, and observed the transit of Mercury with the 12-inch telescope.

During some six months of 1881 he was astronomer, under E. S. Holden, at the University of Wisconsin, where the 15.5-inch telescope of the Washburn Observatory had recently been erected. While there he discovered and measured 88 new double stars, and he measured a large number of double stars "Selected from his MS. General Catalogue of Double Stars, as specially needing observation." These observations appeared in Vol. I. of the *Publications of the Washburn Observatory* in 1882. Mr. Burnham's famous 6-inch refractor ultimately become a part of the equipment at Madison.

On the inauguration of the Lick Observatory in 1888, with professor Holden as director, Mr. Burnham received the appointment as astronomer, and thus had abundant opportunities for the use of the great 36-inch Clark refractor for the continuance of his work. At the Lick Observatory he introduced the principle of using the telescope for all it was worth while the sky permitted: in other words, no part of the night when the sky was clear was given up for any bodily weariness of the observer. In 1892, owing to certain conditions at Mt. Hamilton which were unacceptable to Mr. Burnham, he returned to Chicago, where he was offered the highly responsible position of Clerk of the United States Circuit Court. Incidentally he was receiver of the Chicago and Northern Pacific Railroad Company from 1897 to 1902.

Mr. Burnham was in charge of the expedition from Lick Observatory to observe, at Cayenne, the solar eclipse of December 21-22, 1889. Good results were secured, due in no small measure to Mr. Burnham's large experience in photography. The report was written by Burnham and his associate, Mr. Schaeberle, and published in 1891 in a small volume from the Lick Observatory.

On the inauguration of the Yerkes Observatory in 1897 Burhnam became an active member of the staff, making his observations throughout the nights of Saturday and Sunday and returning to his duties in the court on Monday morning. In 1902 he resigned his position with the court, despite the life tenure of that office. This gave him more time for his astronomical studies, but he still retained his residence in Chicago, coming to Williams Bay for observations on two nights in the week. He became Professor *emeritus* in 1914, at the age of 75, the statute of the University of Chicago requiring retirement at 70 having thus far been waived in his case. Although the opportunity for using the 40-inch telescope still remained open to him as before, he hardly availed himself of it, and his last observations here were made on May 13, 1914.

Vol. II. of the *Publications of the Lick Observatory* contains his observations from August, 1888, to June, 1892, and his fourteenth to nineteenth catalogues of new double stars discovered at the Lick Observatory in that period, including the numbers from β 1026 to β 1274. The search for new doubles was made chiefly with the

excellent 12-inch telescope. He also found some new nebulæ, and measured the positions of numerous planetary nebulæ which are given in the same volume. His orbits for several of the more interesting systems on which he had been working appear at the end of that volume. It will be seen that Mr. Burnham had largely given up the search for new double stars while at the Lick Observatory, regarding it as more important that accurate observations should be made of the systems already discovered, particularly those for which large instruments were necessary.

Vol. I. of the *Publications of the Yerkes Observatory*, issued in 1900, is entitled "A General Catalogue of 1290 Double Stars Discovered from 1871 to 1899 by S. W. Burnham." It gives in order of right ascension the history of all of the Burnham stars up to β No. 1290. Aside from his own observations it summarizes the results of all other observers of these stars and gives diagrams and orbits, by the author and others, of several interesting systems. He did not allow himself to be distracted from his specialty by the allurements of other fields of observation: it was seldom that he looked at nebulæ unless there were double stars to be measured therein; and he had no time for observing comets, however interesting. He made an exception in locating Halley's comet on September 15, 1909, two nights after it had been first caught on a photographic plate by Wolf at Heidelberg: thus Burnham's eye was the first to see the comet, then an extremely faint speck, on this return to perihelion.

During the beginning of Mr. Burnham's use of the 6-inch telescope he felt the great need of a single catalogue of all double stars in the Northern Hemisphere and he therefore arranged a manuscript catalogue of all known double stars within 121° of the north pole. This was conveniently indexed and proved of great service to the observer. He revised it in two MS. editions, the third of which allowed ample room for expansion and is still in use. The preparation of this catalogue had entailed a great amount of labour, as it was constantly kept up to date. Mr. Burnham says of it that "very few will fully appreciate the enormous amount of hard work which has been necessarily expended in the preparation of such a work. . . . It should be remarked in this connection that with the exception of the four years from 1898 to 1902 all this

astronomical work, with the telescope and otherwise, has been done when eight or more hours of at least six days in the week were very much occupied with other and different affairs of life." After his retirement from active observations, Mr. Burnham turned this MS. catalogue and the responsibility of its up-keep over to Professor Eric Doolittle, whose premature death in 1920 is much lamented. From him, by prior arrangement, this passed on to Professor Robert G. Aitken, of the Lick Observatory, who thus carries on the work which will eventually result in a new edition of the "General Catalogue of All Double Stars," now to be mentioned. Efforts had been made for many years to have this great work published, but it could not be brought about until the Carnegie Institution of Washington in 1905 undertook to publish it. The composition was done with great care by the University of Chicago Press, and Part I. was published before the close of 1906. It lists 13,665 double stars and summarizes the numerical information about them, in a quarto volume of 275 pages. Part II., of 1,086 pages, gives details of all important observations of the pairs, with many diagrams. It constitutes a *magnum opus* of which any scientist could be justly proud.

With the 40-inch telescope of the Yerkes Observatory, Mr. Burnham gave no time to the discovery of new doubles. In fact, he avoided them, if possible, and occasionally mentioned seeing some which he did not record. In recent years he took a good deal of interest in the determination of the proper motions of the brighter stars by micrometrically connecting them with neighbouring faint stars, for which a negligible proper motion could be assumed. This work was largely to lay the foundation for a greatly increased knowledge of proper motion in the future. Mr. Burnham realized very fully the great advantage in accuracy that such relative positions, obtained with a telescope of long focus, had over absolute measurements with the meridian circle. His extensive observations in this direction appeared in 1913, in Publication No. 168 of the Carnegie Institution of Washington under the title, "Measures of Proper Motion Stars Made with the Forty-Inch Refractor of the Yerkes Observatory in the Years 1907 to 1912." This is a quarto volume of iv+311 pages and includes a total of about 9,500 measures.

The great General Catalogue contained Mr. Burnham's otherwise unpublished work at Yerkes from 1899 to 1906. Between 1907 and 1911 six extensive papers of his observations appeared in *Astronomische Nachrichten*, and a final collection of measures in the *Astronomical Journal* in 1918.

It will be inferred that Mr. Burnham was a very systematic as well as industrious observer. The writer recalls his answer, to the usual inquiry of what kind of a night he had had, that he had measured 100 pairs besides setting on a number of other stars which were too close to be separated under the particular conditions of "seeing." It should be remembered that these observations were made with a refractor having a focal length of 63.5 feet, and the accomplishment of so much with so large an instrument implies every economy of time in passing from one object to another. His programme was very carefully drawn up and no time was wasted in reversing the telescope, which was always pointed toward the east of the meridian so as to "keep ahead of the game."

Mr. Burnham's experience in the courts gave him a critical view of scientific evidence which is not enjoyed by all scientists. His attitude toward new discoveries, except by men in whom he had confidence, was one of some reserve. It was hard for him to believe that there could exist stars of such short periods as the many found among the spectroscopic binaries; but he ultimately came to believe the results from his confidence in the men who obtained them. In a discussion his premises were often broad, but his logical processes were usually very accurate, so that the conclusions were sound unless he was too tolerant with his premises.

Although an expert in amateur photography, and fully appreciative of the remarkable pioneer work of his colleague Barnard in various astronomical applications of photography, still Mr. Burnham seemed to have a lingering doubt as to the superiority of modern astrometrical procedure on the dry plate, with the use of rectangular co-ordinates, as compared with the visual use of the micrometer for position angle and distance.

Of a genial nature, Professor Burnham had many friends, and was devoted to them; his regard for some of the federal judges with whom he had been associated was little short of veneration. He

always expected that any astronomer passing through Chicago would call upon him; and at least enjoy his hospitality at luncheon.

The duties of his regular life did not make it possible for him to attend many of the meetings of the so-called learned societies. We do not find a record of his having attended a meeting of the Royal Astronomical Society, of which he was a loyal member from 1874 and of which he was elected an associate in 1898. In 1894 he received the Gold Medal of the Society for his researches and the annual address was by the then president, Sir William Abney, who has lately died at an advanced age. The honorary degree of A.M. was bestowed upon Mr. Burnham by Yale University in 1878; the honorary degree of Sc.D. in 1915 by Northwestern University. The Lalande Prize of the French Academy of Sciences was awarded to him in 1904.

The impress left upon his branch of astronomy by Mr. Burnham has been equalled only by his great predecessors, the Struves, Wilhelm and Otto; the Herschels, William and John; and Baron Dembowski—for all of whom he had the greatest admiration, and to the last of whom his "General Catalogue" was dedicated.

Mr. Burnham married in 1868 Mary Cleland, who survives him, with their three sons and three daughters, together with eight grandchildren.

He had been in feeble health for the past two or three years, and suffered a broken hip from a fall, toward the end of February. He died on March 11, 1921, at his home in Chicago.

YERKES OBSERVATORY.

SOME SPECULATIONS ON RELATIVITY

By A. V. Franklin

One of the riddles of time is the age of the sun. It is, perhaps, as fascinating a problem as any, for there is an extraordinary difference in opinion about it between geologists and astronomers.

Geologists, basing their computations on the physical (stratiferous) history of the earth, have done as remarkable things, generally for Time, as astronomers have for Space; and, when they tell us that 300,000,000 years are hidden in the earth's past, we know that their deductions have been many and varied and their results may enter the realms of probability.

Astronomical calculations, on the contrary, are based entirely on the theory of the sun's contraction; which, though a remarkably brilliant theory, is nevertheless highly speculative and, when the result is given as but a fraction of the geologists' figures for the sun to cover the whole solar system as far out as Neptune, we are rather staggered at such vast differences in time between the two theories. More, upon due consideration, we rather incline to believe the geologists.

It must not be forgotten that both parties are agreed as to the continued stability of the sun's heat (the most vital factor) which countenances the contraction theory. The weakness, therefore, in the astronomers' argument must lie in the premise, *i.e.*, the calculated heat of the sun.

This solar heat calculation is arrived at, as we know, from the amount of heat received by the earth in a given time, and the inference drawn that such heat radiates from the sun in equal proportions in all directions.

Now let us see what results "Relativity" might produce in this contraction theory. Immediately, we see that the present calculation of the sun's heat would be incorrect, as radiations in equal proportions in all directions will not suffice, our earth drawing to itself more than its share through gravity. Again it will be

seen that, from the amount of heat received by the earth in a given time, that portion of excess received through gravity must be calculated and deducted before the final computation of the sun's heat is made. And so it would seem that will lead us to believe that, (1) the sun is not burning so fiercely as has been computed; (2) its radiation will be necessarily less; (3) its computed continuous loss of energy greatly lessened.

Thus we find that "Relativity" may upset the present premise to the contraction theory, but, at the same time, may yet be the means of bringing astronomical calculations into some agreement with the geologists' on this problem. For, as we reduce the three factors mentioned in the previous paragraph, so we shall find the period of time for contraction will increase in inverse ratio.

MAGNETIC RESULTS, 1920

By C. A. French

The magnetic work of the Dominion Observatory of the past season was confined for the most part to observing at, or in the vicinity of, stations previously occupied. These stations are in the section of country lying between longitude 57°.4 and 83°.3, and latitude 42°.0 and 51°.4. In all fifty stations were occupied, though this number includes, in some cases, two stations in the same locality. Sixteen of these, eleven being exact re-locations of former stations, are along the north shore of the St. Lawrence river betewen Quebec and Blanc Sablon, Labrador; one, a Carnegie Institution station, is in Newfoundland, and six are along the Intercolonial Railway between Sydney, N.S., and Rivière du Loup, Que. With the exception of Sherbrooke, Que., the remaining are located in the southeastern part of the Province of Ontario.

The results are contained in the two tables A and B, which are given below. The observations at the stations included in the tables were taken by J. A. Pearce and C. A. French, respectively. Included, also, in the tables are some results previously determined. At the majority of the stations the period since the last observation is ten or eleven years. As secular change varies, both as to rate and sign, the dates of the earlier observations at the remaining stations were chosen so that the period at all stations conformed as nearly as possible to ten or eleven years. The deduced average annual change of each of the three elements is also given in the tables.

Of the results given herewith possibly the values representing the average change of declination in Eastern Canada are the most interesting. If the values at the stations along the north shore of the St. Lawrence between Quebec and Blanc Sablon be compared it will be seen that the variation of the "Average Annual Change" is approximately uniform for difference of longitude. At Natashkwan and places west the declination for the period 1910-1920

shows a resultant westerly movement, and at stations east of Harrington Harbour the movement has been to the east. Just how the magnetic declination has been changing throughout the period is somewhat uncertain, but doubtless there has been at some of the westerly stations a westerly movement throughout the period, and at the easterly stations a westerly movement for part of the period and an easterly one for the remainder, the ratio of the times of the two movements varying from station to station. The variation with difference of latitude is also marked. If the results at Harrington Harbour and Sydney, which are approximately in the same longitude, be compared it will be seen that for the period of 11 years at the former station the resultant change is 9′.5 east, that is to say, west declination has decreased by that amount, and at Sydney for 11.1 years the declination has increased 34′.2. For stations west of Quebec the values representing the average annual change are fairly uniform.

At nearly all of the stations east of Quebec the old points were occupied exactly, so that the results are very slightly, if at all, affected by local attraction. At many of the western stations, however, the old sites were not available. At some of these local attraction is much in evidence, consequently no secular change values have been deduced; at others there is some doubt, though values for the average annual change are given.

All the 1920 results have been reduced to International Magnetic Standard, the field instruments having been standardized at the Agincourt Magnetic Observatory in the spring and fall. The earlier results contained in the tables have also been referred to International Magnetic Standard, with the exception of a few values which were taken from reports of other organizations. These latter may require a correction to refer them to the standard adopted for the remaining values, *i.e.*, International Magnetic Standard, but the effect of this correction on the average annual change may, however, be considered negligible.

A +ve sign under "Average Annual Change" of declination indicates that the westerly declination, which is considered −ve, is decreasing and a −ve sign that westerly declination is increasing.

$1\gamma = 0.00001$ c.g.s.

TABLE A. Observer: J. A. PEARCE

Station	Lat.	Long.	Date	Declin.	Dip.	Hor. Int.	Date	Declin.	Dip.	Hor. Int.	Av. Annual Change		
				West		c.g.s.		West		c.g.s.	Dec.	Dip.	Hor. Int.
												′	γ
Sherbrooke	45°23′.2	71°56′.2	1907.7	16°00′.9	75°26′.7	.15100	1920.6	15°29′.7	75°13′.9	.15479	.....		
Cornwall	45°01′.4	74°42′.8	.....	.....	.....	.....	1920.7	12°51′.6	75°21′.9	.15152	.....		
Brockville	44°36′.3	75°40′.7	1907.7	10°35′.2	75°03′.6	.15750	1920.7	10°40′.8	75°05′.9	.15435	.....		
Ottawa	45°23′.6	75°43′.0	1909.5	12°59′.5	75°40′.2	.15130	1920.7	13°42′.3	75°39′.8	.14836	−3.8	0.0	−26
Renfrew	45°28′.5	76°41′.0	1913.5	11°45′.8	76°02′.4	.14739	1920.6	12°19′.4	76°04′.9	.14491	−4.7	0.3	−35
Sharbot Lake	44°46′.0	76°41′.2	1907.6	11°29′.7	74°54′.6	.16060	1920.7	12°30′.4	74°53′.8	.15768	−4.6	−0.1	−22
Belleville	44°07′.1	77°25′.5	1910.9	8°56′.0	74°55′.0	.15745	1920.7	9°44′.8	74°56′.0	.15399	−5.0	0.1	−35
Chalk River	46°00′.8	77°27′.4	1913.5	11°00′.5	76°21′.7	.14475	1920.6	11°27′.4	76°22′.2	.14319	−3.8	0.1	−22
Newcastle	43°54′.3	78°31′.8	1910.9	7°48′.5	74°43′.3	.16068	1920.7	8°12′.5	74°46′.2	.15756	−2.4	0.3	−32
Kinmount, A	44°47′.6	78°38′.0	1910.8	8°41′.6	75°16′.9	.15473	1920.7	5°51′.7	74°58′.4	.15934	.....		
Kinmount, B	44°48′.2	78°38′.0	.....	.....	.....	.....	1920.7	9°54′.2	75°22′.0	.15216	.....		
Mattawa	46°19′.5	78°42′.5	1913.5	9°27′.8	76°40′.7	.14210	1920.6	9°58′.0	76°41′.2	.13969	−4.3	0.1	−34
Joe Lake	45°34′.7	78°46′.5	1907.6	7°31′.6	75°56′.0	.15230	1920.6	7°48′.2	76°08′.0	.14832	.....		
Port Colborne	42°53′.2	79°14′.3	1910.7	5°48′.5	73°58′.1	.16738	1920.5	6°26′.2	74°05′.7	.16362	−3.8	0.8	−38
North Bay	46°19′.0	79°27′.7	1913.5	9°03′.4	76°38′.4	.14256	1920.6	9°34′.7	76°36′.6	.14074	−4.4	−0.3	−26
Beamsville	43°11′.5	79°28′.5	1910.7	5°52′.3	74°31′.4	.16465	1920.5	6°30′.1	74°38′.0	.16099	−3.9	0.7	−37
Penetanguishene	44°46′.4	79°58′.0	1910.8	7°30′.6	75°32′.4	.15308	1920.6	8°05′.9	75°34′.2	.15038	−3.6	0.2	−28
Parry Sound	45°21′.6	80°02′.6	1916.4	7°53′.2	75°41′.3	.15052	1920.6	8°09′.4	75°40′.0	.14933	−3.9	−0.3	−28
Kitchener	43°26′.9	80°30′.0	1910.7	5°35′.0	74°27′.7	.16451	1920.5	6°17′.5	74°32′.8	.16120	−4.3	0.5	−34
Byng Inlet	45°47′.0	80°33′.6	1916.4	8°02′.8	76°06′.0	.14779	1920.6	7°50′.3	75°49′.6	.14942	.....		
Owen Sound	44°13′.3	80°55′.0	1910.8	6°02′.5	75°13′.4	.15688	1920.6	6°40′.0	75°16′.0	.15383	−3.8	0.3	−31
Port Stanley	42°39′.9	81°13′.5	1910.7	2°41′.7	74°05′.4	.16689	1920.5	3°13′.0	74°13′.3	.16292	−3.2	0.8	−41
Goderich	43°45′.7	81°42′.5	1910.8	4°33′.3	74°31′.6	.16363	1920.5	5°12′.1	74°38′.4	.16006	−4.0	0.7	−37
Sarnia	42°57′.7	82°22′.5	1910.6	3°02′.3	73°50′.5	.17029	1920.5	3°19′.1	73°58′.6	.16654	.....		
Kingsville	42°02′.2	82°45′.8	1910.7	1°33′.1	73°06′.9	.17647	1920.5	2°03′.0	73°18′.8	.17235	−3.1	1.2	−42
Windsor	42°17′.9	83°15′.0	1910.7	2°00′.0	73°14′.6	.17530	1920.5	2°39′.3	73°24′.4	.17132	−4.0	1.0	−41

TABLE B.

Observer: C. A. FRENCH

Station	Lat.	Long.	Date	Declin.	Dip.	Hor. Int.	Date	Declin.	Dip.	Hor. Int.	Av. Annual Change Dec.	Dip.	Hor. Int.
				West		c.g.s.		West		c.g.s.	′	′	γ
Blanc Sablon, Labrador	51°25′.8	57°11′.6	.....	.....	.....	.....	1920.7	32°19′.9	76°04′.9	.13607	.....		
Greenly Island	51°22′.8	57°13′.5	1909.7	33°30′.0	76°00′.9	.13944	1920.7	33°14′.0	75°40′.6	.13979	1.4	−1.8	3
Salmon Bay	51°25′.3	57°38′.8	1909.7	30°38′.9	76°29′.2	.13432	1920.7	30°25′.1	76°10′.0	.13472	1.3	−1.7	4
Humbermouth (Bay of Islands)	48°58′.3	58°00′.0	1909.6	30°33′.0	75°13′.0	.14717	1920.7	30°30′.5	74°57′.0	.14727	0.2	−1.4	4
St. Augustine River	51°13′.4	58°42′.4	.....	.....	.....	.....	1920.6	33°24′.1	76°05′.2	.13841	.....		
Mutton Bay	50°46′.6	59°06′.0	1909.7	30°14′.5	76°52′.0	.13505	1920.6	29°58′.9	76°34′.1	.13534	1.4	−1.6	3
Harrington Harbour	50°30′.1	59°28′.8	1909.6	31°20′.2	76°23′.9	.13667	1920.6	31°10′.5	76°04′.0	.13708	0.9	−1.8	4
Sydney	46°08′.8	60°11′.6	1909.6	25°28′.0	74°12′.0	.15719	1920.7	26°02′.2	74°02′.2	.15580	−3.1	−0.9	−13
Natashkwan	50°11′.3	61°55′.6	1909.6	29°36′.1	76°48′.6	.13481	1920.6	29°41′.4	76°31′.6	.13497	−0.5	−1.5	1
Truro	45°21.3′	63°16′.6	1912.7	22°31′.7	73°50′.8	.16264	1920.7	22°56′.2	73°42′.3	.16110	−3.1	−1.1	−19
Eskimo Point, A.	50°14′.6	63°42′.3	1909.6	35°25′.5	76°36′.1	.13832	1920.6	35°33′.2	76°20′.0	.13840	−0.7	−1.6	1
Eskimo Point, B.	50°14 .6	63°42′.3	.....	.....	.....	.....	1920.6	34°45′.6	76°18′.9	.13840	.....		
Moncton	46°05′.0	64°47.2′	1912.6	22°42′.5	75°01′.7	.15211	1920.7	23°10′.7	74°55′.0	.15056	−3.5	−0.8	−19
Seven Islands (Pointe aux Basques)	50°11′.2	66°23′.9	.....	.....	.....	.....	1920.6	26°53′.9	77°35′.6	.12740	.....		
Seven Islands	50°13′.0	66°25′.0	1909.5	27°03′.9	77°51′.4	.12654	1920.6	27°23′.1	77°34′.4	.12660	−1.7	−1.5	1
Matapedia	47°58′.5	66°57′.0	1912.5	23°22′.0	76°28′.5	.13943	1920.7	23°48′.6	76°20′.2	.13856	−3.2	−1.0	−11
Godbout, A	49°19′.0	67°37′.5	1909.5	24°31 .9	77°37 .3	.12961	1920.5	24°55 .9	77°20 .0	.12929	−2.2	−1.6	− 3
Godbout, B	49°19 .0	67°37′.5	.....	.....	.....	.....	1920.5	24°53′.7	77°20′.8	.12937	.....		
Rimouski	48°29′.6	68°30′.7	1911.7	22°51′.0	76°49 .0	.13810	1920.5	23°21′.8	76°40′.6	.13770	−3.5	−1.0	− 5
Bersimis	48°56′.1	68°40′.4	1909.4	21°01′.0	77°54′.0	.12824	1920.5	21°35′.5	77°41′.2	.12765	−3.1	−1.1	− 5
Rivière du Loup	47°51′.6	69°33′.2	1912.5	21°12′.0	76°32′.2	.14091	1920.5	21°34′.4	76°24′.0	.13973	−2.8	−1.0	−15
Tadoussac	48°08′.5	69°42′.5	1909.7	20°18′.1	77°17′.0	.13403	1920.5	20°56′.9	77°04′.6	.13342	−3.6	−1.1	− 6
Quebec	46°48′.0	71°15′.2	1909.7	18°19′.8	76°01′.0	.14773	1920.8	19°02′.5	75°53′.8	.14545	−3.8	−0.6	−21
Ottawa	45°23′.6	75°43′.0	1909.5	12°59′.5	75°40′.2	.15130	1920.4	13°42′.4	75°38′.8	.14861	−4.0	0.0	−25
Ottawa	45°23′.6	75°43′.0	.....	.....	.....	.....	1920.8	13°46′.2	75°41′.0	.14842			

Dominion Observatory, Ottawa,
March 29, 1921.

COMPARISON OF WIRELESS TIME SIGNALS

By R. Meldrum Stewart

It has been the custom for several years to receive the wireless time signals sent out daily by the U.S. Naval Station Arlington, for the purpose of comparison with Dominion Observatory time. During a part of November and December last comparisons were also made with the signals from Mare Island, San Francisco, from Darien, Panama, and from Lyons, France. The comparisons were originally undertaken with the hope of deriving some approximate data as to the accuracy of the assumed differences of longitude of the observatories concerned. Though, on account of the irregularity of the signals, this hope was not fulfilled, it has been thought that the results might prove of some interest.

The comparisons with the above stations are contained respectively in Tables I, II and III; the last column in each case contains the errors of the signals as compared with our Riefler Clock, a positive sign indicating that the signals were late; the times given are in all cases Eastern Standard Time. For the sake of comparison the results for Arlington (or in some cases Annapolis) for the same period are given in Table IV; in this case two columns of corrections are given, the first being uncorrected for Washington clock-errors, the second embodying the monthly list of corrections promulgated by the U.S. Naval Observatory.

Table V contains the observed clock corrections at Ottawa, upon which the comparisons are based.

Many of the comparisons were made by Messrs. J. P. Henderson and W. A. Dier of the Observatory staff.

Dominion Observatory,

Ottawa,

Apr. 11th, 1921.

TABLE I.—TIME SIGNALS FROM SAN FRANCISCO

1920 Date	Time	Error	Date	Time	Error	Date	Time	Error
		s			s			s
Nov. 17	1 a.m.	−.19	Dec. 2	1 a.m.	+.46	Dec. 15	1 a.m.	+.72
18	"	−.28	3	"	+.33	16	"	+.89
21	"	−.38	4	"	+.37	17	"	+.95
22	3 p.m.	−.50	5	"	+.64	18	"	+.97
25	1 a.m.	+.01	6	"	+.60	20	"	+.07
	3 p.m.	−.19	7	"	+.69	21	"	+.05
27	1 a.m.	−.34	8	"	+.38	23	"	+.17
	3 p.m.	−.25	9	"	+.18	25	"	+.33
28	1 a.m.	−.16		3 p.m.	+.09	26	"	+.47
29	"	+.36	11	1 a.m.	+.07	27	"	+.21
30	"	+.58	12	"	+.02	30	"	+.19
Dec. 1	"	+.56	14	"	+.66	31	"	+.15

TABLE II.—TIME SIGNALS FROM DARIEN

1920 Date	Time	Error	Date	Time	Error	Date	Time	Error
		s			s			s
Nov. 12	1 p.m.	+.30	Nov. 20	1 p.m.	.00	Dec. 1	1 p.m.	+.12
13	"	+.16	21	"	−.36	3	"	+.10
15	"	−.07	22	"	−.53	4	"	−.65
16	5 a.m.	−.37	23	"	−.88	9	5 a.m.	−.07
	1 p.m.	−.49	24	"	.00	11	1 p.m.	+.14
17	5 a.m.	−.74	25	"	−.05	14	"	+.09
	1 p.m.	−.29	26	"	+.07	19	"	−.02
18	5 a.m.	−.63	27	"	+.16	20	"	+.10
	1 p.m.	−.52	28	"	+.24	26	"	+.11
19	"	+.13	29	"	+.14			

TABLE III.—TIME SIGNALS FROM LYONS (4 a.m.)

1920 Date	Error	Date	Error	Date	Error
	s		s		s
Dec. 4	+.04	Dec. 12	+.30	Dec. 24	+.51
5	+.20	14	+.37	26	.56
6	+.22	16	+.13	27	.41
7	+.44	17	+.22	28	.63
9	+.21	18	+.24	29	.44
10	+.51	21	+.41	30	.61
11	+.37	23	+.39	31	.59

TABLE IV.—TIME SIGNALS FROM ARLINGTON

1920 Date	Time	Obs'd Error	Corr'd Diff.	Date	Time	Obs'd Error	Corr'd Diff.
		s	s			s	s
Nov. 12	Noon	+.27	+.11	Dec. 6	Noon	−.05	−.02
	10 p.m.	+.29	+.11		10 p.m.	−.03	−.03
13	Noon	+.08	+.10	7	Noon	+.02	−.02
	10 p.m.	+.04	+.07		10 p.m.	+.02	−.02
14	Noon	+.07	+.06	8	Noon	+.01	−.02
	10 p.m.	+.03	+.01	9	10 p.m.	+.06	+.01
15	Noon	+.06	+.04	10	Noon	+.02	−.01
16	Noon	−.02	.00		10 p.m.	+.05	+.01
	10 p.m.	−.02	+.03	11	Noon	−.03	−.01
17	Noon	−.02	.00		10 p.m.	−.01	−.01
	10 p.m.	.00	+.01	12	Noon	−.02	−.01
18	Noon	−.04	−.03		10 p.m.	−.01	.00
19	Noon	−.07	−.01	13	Noon	−.01	+.01
20	Noon	−.11	−.03		10 p.m.	+.01	+.05
	10 p.m.	+.04	.00	14	Noon	+.01	+.04
21	Noon	−.10	−.10	15	10 p.m.	−.01	+.05
	10 p.m.	+.03	.00	16	10 p.m.	.00	+.05
22	Noon	−.10	−.11	17	Noon	−.02	+.06
	10 p.m.	−.12	−.12		10 p.m.	+.01	+.06
23	Noon	−.10	−.10	18	Noon	+.05	+.03
	10 p.m.	−.08	−.11		10 p.m.	+.13	+.08
24	Noon	−.06	−.05	19	Noon	+.10	+.06
	10 p.m.	−.06	−.06		10 p.m.	+.12	+.05
25	Noon	−.06	−.03	20	Noon	+.10	+.03
	10 p.m.	−.03	−.04		10 p.m.	+.15	+.06
26	Noon	−.10	−.08	21	Noon	+.03	+.01
27	Noon	−.06	−.05		10 p.m.	+.03	.00
	10 p.m.	−.02	.00	22	Noon	+.07	+.03
28	Noon	+.05	+.08		10 p.m.	+.11	+.07
	10 p.m.	+.07	+.08	23	Noon	+.10	+.05
29	Noon	+.08	+.11		10 p.m.	+.13	+.06
	10 p.m.	+.04	+.07	24	Noon	+.08	+.07
30	Noon	.00	+.07		10 p.m.	+.08	+.07
	10 p.m.	+.04	+.13	25	10 p.m.	+.15	+.11
Dec. 1	10 p.m.	+.04	+.04	26	10 p.m.	+.10	+.06
2	10 p.m.	+.07	+.07	27	Noon	+.11	+.07
3	Noon	+.06	+.06		10 p.m.	+.11	+.08
	10 p.m.	+.01	+.02	28	Noon	+.14	+.10
4	Noon	.00	+.02	29	10 p.m.	+.12	+.11
	10 p.m.	−.08	−.01	30	10 p.m.	+.12	+.12
5	Noon	−.07	−.07	31	10 p.m.	+.15	+.14
	10 p.m.	−.05	−.02				

TABLE V.—OBSERVED CLOCK CORRECTIONS AT OTTAWA

1920 Date	Mean Time	ΔT	Rate
		s	s
Nov. 10	8.45 p.m.	+9.241	.112
15	9.30 "	9.806	.118
28	8.25 "	11.331	.072
Dec. 2	10.40 "	11.627	.058
8	6.55 "	11.966	.094
17	9.50 "	12.827	.085
21	6.30 "	13.157	.116
24	7.25 "	13.511	.093
28	6.45 "	13.882	.088
31	6.10 "	14.144	

MAGNETIC RESULTS, 1919-1920

By G. Blanchard Dodge

During the season of 1920 Dip and Force observations were made at 6 stations, including the repeat station at Devona, the usual number of observations being greatly restricted on account of sickness. They are given below, R. C. Purser, Esq., D.L.S., being the observer.

As in previous years all observations for Declination, Dip and Force have been reduced to International Magnetic Standard by direct comparison at the beginning and end of the season with the magnetic standards of the Magnetic Observatory, Agincourt, by courtesy of the Director of the Meteorological Service of Canada. The Declination observations have been reduced to mean of month by direct comparison with the continuous declination magnetograms of the Magnetic Observatory of Meanook, Alberta, supplied by the Director of the Meteorological Service of Canada.

During the season of 1919 some 26 stations were reoccupied for Declination repeat observations, the results being given below. The Dip and Force observations for 1919 were published in the July, 1920, number of this Journal. Over 900 declination observations completed the work accomplished during 1919.

Magnetic Results, 1920

Place	Long.	Lat.	Date	Dec.	Dip	H. C.G.S.	F. C.G.S.	Observer
	° ′	° ′		° ′	° ′			
Normandeau..	111 44	54 35	July 18	27 13	78 22	.1245	.6175	R. C. Purser
Sirbertville...	113 50	51 38	June 13-14	25 01	75 46	.1502	.6107	"
Livingstone River.....	114 25	50 03	Sept. 12	23 38	74 20	.1638	.6066	"
Highvale.....	114 35	53 31	May 30	26 56	77 07	.1374	.6160	"
			June 1					
Leyland.....	117 20	53 01	Aug. 1	27 57	75 44	.1500	.6085	"
Devona.....	118 00	53 09	July 27	27 32	75 43	.1496	.6066	"

DECLINATION REPEAT OBSERVATIONS, 1919

Locality	Long.	Lat.	Date	Dec.	Observer
	° ′	° ′		° ′	
Manigotagan R.	96 17	51 07	1914.8	11 22	W. J. Deans
			1919.5	11 10	B. W. Waugh
Assiniboine R.	100 58	50 05	1909.5	17 54	O. Rolfson
			1919.7	16 59	G. A. Bennett
Mayfield	101 33	49 53	1913.7	16 02	A. G. Stuart
			1919.5	15 52	C. Rinfret
Nut Mtn. I	103 06	52 11	1909.9	21 52	E. W. Hubble
			1919.8	21 03	P. M. H. LeBlanc
Nut Mtn. II	103 06	52 11	1909.9	21 58	E. W. Hubble
			1919.8	21 18	P. M. H. LeBlanc
Quill Plain	103 21	51 46	1915.7	19 57	W. A. Fletcher
			1919.6	19 37	P. M. H. LeBlanc
Margo	103 22	51 49	1915.8	19 28	W. A. Fletcher
			1919.6	19 24	P. M. H. LeBlanc
Kuroki I	103 27	51 48	1914.0	18 45	R. C. Purser
			1919.6	18 24	P. M. H. LeBlanc
Kuroki II	103 28	51 52	1914.0	18 48	R. C. Purser
			1919.6	18 28	P. M. H. LeBlanc
Balgonie	104 16	50 27	1911.5	18 54	C. Rinfret
			1919.4	18 37	L. E. Fontaine
Balgonie	104 16	50 29	1911.5	18 54	C. Rinfret
			1919.4	18 16	L. E. Fontaine
Kronau	104 17	50 13	1915.6	18 48	C. Rinfret
			1919.6	18 40	L. E. Fontaine
Pilot Butte	104 23	50 27	1911.5	18 44	C. Rinfret
			1919.0	18 28	L. E. Fontaine
Moosejaw	105 32	50 24	1910.7	19 53	Dom. Observatory
			1919.9	19 29	L. E. Fontaine
Thelma	110 12	49 29	1912.5	21 51	E. S. Martindale
			1919.5	21 22	G. C. Cowper
Minda I	110 38	49 26	1913.5	22 32	A. M. Narraway
			1919.5	22 13	C. G. Cowper
Minda II	110 34	49 27	1913.5	22 32	A. M. Narraway
			1919.5	21 56	G. C. Cowper
Ranchville	110 37	49 33	1911.5	22 55	E. S. Martindale
			1919.5	22 20	G. C. Cowper
Catchem	110 43	49 21	1910.5	22 46	C. F. Miles
			1919.5	22 15	G. C. Cowper

DECLINATION REPEAT OBSERVATIONS, 1919—*Continued.*

Locality	Long.	Lat.	Date	Dec.	Observer
Comrey	110 45	49 07	1912.4	22 10	G. M. Walker
			1919.5	21 43	G. C. Cowper
Aden	111 16	49 05	1913.6	22 37	A M. Narraway
			1919.6	22 16	G. C. Cowper
St. Paul de Metis	111 22	53 59	1909.7	26 22	H. S. Holcroft
			1919.8	25 54	H. M. R. Soars
Kippenville	111 31	49 07	1911.5	23 10	P. B. Street
			1919.6	22 46	G. C. Cowper
Thorhild	113 01	54 09	1908.9	27 29	G. J. Lonergan
			1919.5	27 25	H. M. R. Soars
Peace River	117 21	56 44	1913.2	31 59	J. R. Akins
			1919.6	31 38	F. V. Seibert
Salmon River	119 28	50 28	1915.4	26 25	C. H. Taggart
			1919.5	25 56	J. R. Vicars

TOPOGRAPHICAL SURVEYS,
INTERIOR DEPARTMENT.
February, 1921.

MAGNITUDE OF STARS

OTTO KLOTZ

The following note leading to the derivation of the now frequently occurring formula,

$M = m + 5 + 5 \log \pi$, may be of interest.

In the latter M is the absolute magnitude of the star, m its apparent mangitude, and π its parallax in seconds of arc. The *absolute magnitude* for all stars is referred to the uniform distance having the parallax of $0''.1$, or ten parsecs.

Sir John Herschel found that the light given by a star of the first magnitude was about 100 times as great as a star of the sixth magnitude, the latter being about the limit of naked eye vision. The division into six magnitudes of the naked eye stars is quite arbitrary. If two light intensities, that can just be distinguished by the eye, be increased proportionately the eye would still similarly differentiate them. Estimation by the eye of a small difference of two light intensities is proportional to this difference divided by the intensity. Hence if we put the brightness of a star at b, the small difference $\mathrm{d}b$, while the corresponding difference of magnitude is $-\mathrm{d}M$, and k an arbitrary constant, we have

$$-\mathrm{d}M = k\frac{\mathrm{d}b}{b}.$$

The indefinite integral of which is

$$M = -k \log b + \mathrm{C}.$$

Integrating between limits we have

$$M_{m+1} - M_m = k\,(\log b_m - \log b_{m+1}),$$

also $M_{m+n} - M_m = k\,(\log b_m - \log b_{m+n})$.

Since $M_{m+1} - M_m = 1$, and $M_{m+n} - M_m = n$

by eliminating k we obtain

$$\log \frac{b_m}{b_{m+1}} = \frac{1}{n} \log \frac{b_m}{b_{m+n}}$$

$$\text{or} \quad n = \log\left(\frac{b_m}{b_{m+n}}\right) / \log\left(\frac{b_m}{b_{m+1}}\right).$$

For the last term various values, from .37 to .46, have been found or assigned by different observers, but the value suggested by Pogson of .40 has been adopted.

Hence we may write $n = 2.5 \log b_m / b_{m+n}$.

.40 is the log of the number that expresses the ratio of brightness between two successive magnitudes, m and m and $m+1$. $10^{.4} = 2.512$, which is this ratio.

While the magnitudes follow in arithmetical progression the corresponding brightness follows the exponential law.

In the formula b does not express absolute brightness, only relative brightness.

From our general expression $M = -k \log b$ it is seen that for magnitude 0, $\log b = 0$, *i.e.*, $b = 1$, unity brightness.

Hence if in our equation for n we take $m = 0$, n will express the magnitude of a star,

and $$n = 2.5 (\log b_m - \log b_{m+n})$$
$$= -2.5 \log b_n;$$

in calling now m the magnitude of a star and b its corresponding brightness we have

$$m = -2.5 \log b, \text{ which is Pogson's equation.}$$

For positive values of m, $\log b$ is essentially negative, b being a fraction. As the magnitude increases the brightness decreases.

Referring now to the equation at the beginning of this note, if b and B are the corresponding values of brightness for the above m and M magnitudes we have the relation $b/B = 10^2/d^2$ where d is the distance of the star.

Now the distance is inversely proportional to the parallax π; hence we may write $b/B = 10^2\pi^2$.

Taking logs we have

$$\log b - \log B = 2 \log 10 + 2 \log \pi = 2 + 2 \log \pi.$$

Multiplying by 2.5, we have

$$2.5 \log b - 2.5 \log b = 5 + 5 \log \pi.$$

Substituting the Pogson equation, we have

$$-m + M = 5 + 5 \log \pi$$

and $$M = m + 5 + 5 \log \pi.$$

DOMINION OBSERVATORY, OTTAWA.

April 20, 1921.

NOTES FROM THE METEOROLOGICAL SERVICE

MAY, 1921

TEMPERATURE

The temperature was above the average throughout the Dominion, except in the Northern Portion of British Columbia, and in parts of Alberta and Saskatchewan, where it was slightly below the average. In Southern British Columbia the positive departure was 1 to 2 degrees, in the Western Provinces from 1 to 3 degrees, in Ontario and Quebec from 3 to 6 degrees, and in the Maritime Provinces from 2 to 4 degrees.

PRECIPITATION

The precipitation was above the average in Saskatchewan, also over the greater portion of Manitoba. In Alberta and Quebec it was everywhere below the average. In British Columbia, Ontario and the Maritime Provinces it was also below the average, except in a few scattered localities. Some of the chief negative departures were Calgary, 1.80 inches; Parry Sound, 1.50 inches; London, 1.80 inches; Haileybury, 1.70 inches; Montreal, 1.90 inches; Quebec, 2.30 inches; St. John, 2.10 inches. Noticeable positive departures were Prince Albert, 2.00 inches; Minnedosa, 1.50 inches; Beatrice, Ont., 1.50 inches; Halifax, 2.40 inches.

JUNE, 1921

TEMPERATURE

The temperature was above the average over the Dominion, except in the Maritime Provinces, where it was just average. The chief positive departures occurred in the Western Provinces and in Ontario, and varies between 3 and 9 degrees and 1 and 6 degrees respectively.

Precipitation

There was a marked deficiency of rain over the Dominion as a whole, Southern Alberta, Northern Ontario, Quebec, and the Maritime Provinces, suffering the most severely. There was an excess, however, over a large portion of British Columbia, Eastern Saskatchewan, and a few comparatively small districts in Ontario.

July, 1921

Temperature

The mean temperature was a little below the normal on the Pacific Coast, and above in all other parts of the Dominion, the positive departures being greatest from 9° to 11° in Central and Northern Ontario. In many parts of Ontario and Quebec it was the warmest July on record and temperatures of well over 90° were of common occurrence, and in several places in the former province 100° and slightly above were registered.

Precipitation

The rainfall over the Dominion was unevenly distributed. In British Columbia and Southern Alberta, also in the Maritime Provinces, it was much less than normal, while in the other provinces, it was quite heavy in some places and very light in others. This was particularly noticeable in Manitoba where four to six inches fell in many sections, while in a few others the total fall was less than one inch. There also was a decided variance in Ontario, where some districts received less than two inches and others as much as six to eight inches.

MAGNETIC DISTURBANCES, MAY, 1921

A disturbance of magnitude began on morning of the 12th, and was practically continuous until the 21st. From the 13th, to 16th, the movements of all the elements were frequently beyond the scope of the photographic register. There was also a moderate disturbance from 19th to 20th, and few of the remaining daily curves were free from perturbance.

The elements showed ranges as follows.

	D	H	Z
	° ′	γ	γ
May 13th	3.50	856	683
May 14th	3.24	1118	998
May 15th	3.40	753	418
May 16th	3.40	816	808

It is impossible to approximate the amplitudes for Meanook.

Aurora on 16th, and 17th, of 1st class, giving sufficient light for reading at 24 o'clock of 17th. W. E. W. J.

SEISMOLOGICAL NOTES FOR MAY, 1921

During the month Toronto recorded 13 disturbances and Victoria 12. This is about 4 greater than the normal number. They were all comparatively small, with the exception of the one on the 1st when Victoria trace amplitude was 3 mm. and Toronto 2 mm. This earthquake was centred off Tejupan Point, Mexico.

J. Y.

SEISMOLOGICAL NOTES FOR JUNE, 1921

There was a marked decrease in seismological activity during the month, both as regards frequency and amplitude, Toronto and Victoria recording only six disturbances. The greatest amplitude was 0.4 mm. on the Toronto trace on the 30th, the distance being 3070 km. This disturbance was not recorded at Victoria.

J. Y.

SEISMOLOGICAL NOTES FOR JULY, 1921

Toronto recorded nine disturbances during the month, and Victoria seven. The majority were of very small amplitude. The largest were 0.6 mm. on the 13th, and 0.5 mm. on the 31st. The latter quake was centred 4670 km. from Victoria. The preliminary phases of this quake were poorly defined on the Toronto record.

J. Y.

TEMPERATURES FOR MONTHS OF MAY, JUNE AND JULY, 1921

STATIONS	MAY		JUNE		JULY	
	Highest	Lowest	Highest	Lowest	Highest	Lowest
Yukon						
Dawson	74	20	82	32	86	34
British Columbia						
Atlin	64	26	70	32	70	32
Agassiz	83	35	81	39	84	45
Barkerville	65	24	71	30	73	29
Kamloops	89	34	87	42	94	44
New Westminster	78	37	76	47	80	47
Prince Rupert	76	34	..	..	66	40
Vancouver	76	35	72	45	79	45
Victoria	72	39	70	46	78	48
West Provinces						
Battleford	81	30	86	31	94	46
Calgary	82	26	86	24	96	36
Edmonton	78	27	82	33	87	30
Medicine Hat	89	32	96	47	..	..
Minnedosa	79	24	89	28	90	44
Moosejaw	80	20	96	30	100	41
Oakbank	83	23	90	32	90	46
Portage la Prairie	87	25	94	35	99	52
Prince Albert	80	27	86	30	86	46
Qu'Appelle	80	23	87	26	90	43
Regina	80	15	94	29	95	41
Saskatoon	80	26	88	30	95	47
Souris	79	22	93	34	96	48
Swift Current	80	24	96	34	100	44
Winnipeg	85	23	94	32	94	49
Ontario						
Agincourt	89	31	92	42	96	57
Oak Ridges	90	30	90	38	97	51
Bancroft	88	27	87	30	97	48
Barrie	90	28	..	..	93	55
Beatrice	85	24	91	31	98	48
Bloomfield	81	32	88	41	96	57
Brantford	..	..	..	..	..	..
Chapleau	87	32	88	39	93	41
Chatham	93	33	98	37	101	57
Clinton	87	31	89	33	97	50
Collingwood	93	35	102	40	94	51
Cottam	86	30	96	39	97	50
Georgetown	80	30	88	38	94	54
Goderich	..	..	..	..	..	..
Gravenhurst	95	30	94	37	..	..
Grimsby	89	34	92	44	99	60
Guelph	85	29	87	40	94	51
Haliburton	89	25	102	31	100	46
Huntsville	84	27	92	34	97	48
Ontario—cont.						
Kenora	81	22	93	36	96	48
Kinmount	..	..	..	..	..	..
Kitchener	88	30	86	45	98	52
Kingston	82	36	90	37	89	63
London	90	31	94	36	100	54
Lucknow	88	27	89	30	96	45
Markdale	..	..	..	..	..	..
North Gower	88	33	92	40	98	50
Oshawa	82	32	85	40	91	59
Ottawa	92	36	94	41	98	53
Paris	90	30	93	38	100	54
Parry Sound	86	29	96	38	100	53
Peterborough	91	28	93	38	98	55
Port Arthur	80	24	86	32	92	42
Port Burwell	78	32	83	40	87	55
Port Dover	80	34	88	42	90	59
Port Stanley	..	..	86	38	90	54
Queensborough	90	28	91	34	99	50
Ronville	84	27	92	36	94	45
Southampton	83	30	85	40	91	52
Sundridge	..	..	..	..	..	..
Stonecliffe	94	18	93	..	104	46
Stoney Creek	89	33	91	38	98	55
Toronto	87	33	91	45	98	59
Uxbridge	89	29	85	38	93	54
Wallaceburg	..	..	95	66	99	54
Welland	86	32	88	41	96	57
White River	87	16	92	22	96	40
Quebec						
Brome	86	..	87	..	..	..
Father Point	68	28	74	34	88	40
Montreal	89	40	92	46	95	55
Quebec	87	34	87	41	96	51
Sherbrooke	86	29	..	..	97	51
Maritime Provinces						
Charlottetown	76	32	80	36	90	48
Chatham	84	28	86	36	94	46
Dalhousie	..	..	..	..	..	..
Fredericton	..	..	86	30	96	41
Halifax	82	30	82	40	86	50
Moncton	85	29	86	33	91	41
St. John	78	30	80	42	80	48
St. Stephen	..	..	..	..	..	..
Sussex	84	25	82	36	91	37
Sydney	70	30	84	36	90	42
Yarmouth	74	32	74	40	82	47

ASTRONOMICAL NOTES

RESEARCHES ON THE STELLAR ATMOSPHERES

Recherches sur l'atmosphère des étoiles. Reconnaissance de la couche supérieure dans quelques étoiles et comparaison avec le Soleil by H. Deslandres and V. Burson. (*C.R.* 1921, p. 729.)

Professor Deslandres, the great French authority on solar physics, discovered in 1892 and 1894 that the rays of calcium H and K in the solar spectrum are double reversals, *i.e.*, are composed of wide absorption lines H_1 and K_1 on which are superposed narrower emission lines H_2 and K_2, and on which again are found still narrower absorption lines H_3 and K_3. Professor Deslandres, by the use of the spectroheliograph which he invented, succeeded in photographing the separate parts of the solar atmoshpere which give rise to these different lines. In this way it was found that the rays H_3 and K_3 have their origin at a much higher level in the solar atmosphere than the rays H_2 and K_2 (which are very prominent in the regions of faculae), the last ones having also their origin at a much higher level than the rays H_1 and K_1.

It was interesting, now, to find out whether the lines H_2 and K_2, as well as the lines H_3 and K_3, were present in stellar spectra. Professor Deslandres and his assistant, Mr. Burson, found, first, that H_2 and K_2 were present in a few star spectra of classes G and K and suggested that in these spectra H_3 and K_3 might be detected by the use of a larger dispersion spectrograph. After this they found that both sets (H_2 and K_2) and (H_3 and K_3) were present in Epsilon Geminorum and Alpha Orionis, stars being respectively of classes G_8 and Ma. They estimated that H_3 and K_3 were, in these stars, about five times as wide as in the sun.

These results of the French scientists, especially concerning Alpha Orionis, are most interesting, especially in view of the fact that the diameter of this star has just been determined at the Mt. Wilson Observatory by the Michelson interferometer method. Alpha Orionis is a giant star, but most likely a greater giant in volume than in mass, hence its density must be small; on this account the larger widths of K_3 probably cannot be explained by greater density, but most likely must depend on the electrical conditions of the star's outer atmoshpere as suggested by Professor Deslandres. F. H.

A NEW OBSERVATORY IN JAVA

A new astronomical society has been founded in Bandoeng, Java (Dutch East Indies), with the intention of building an astrophysical observatory. Mr. Bosscha will, at his own expenses, purchase a refractor of about 30 feet focal length and give it to the society. The plantation company, Baroe Adjak, gracefully gave the society a large piece of land on a hill near Lembang, which will be the site of the observatory.

The honorary president of the new society is Mr. Swart, Vice-President of the Council of the Dutch East Indies. The president is Mr. Bosscha and the secretary Mr. Van Kerkhoven. The Vice-Admiral, W. J. G. Umbgrove, and Professor J. Klopper are members of the council. The annual subscription to the society is ten Dutch guldens. F H.

OBSERVATIONS OF MARS DURING THE LAST OPPOSITION

Observations et photographies de Mars faites a l'Observatoire Flammerion de Juvisy pendant la dernière opposition by F. Quènisset (*L'Astronomie*, 1921, February, p. 64).

Everyone knows Flammarion's Observatory and the valuable work which is being done there, especially on the planets. Its principal observers are the famous Flammarion himself, as well as Mrs. Flammarion (formerly Miss Gabrielle Renoudot), and Mr. Quènisset. Miss Renaudot assumed the difficult task of being secretary of the French Astronomical Society during the war, and M. Quènisset is also well known as a superior observer.

According to M. Quènisset the most remarkable peculiarities of the last opposition of Mars were: Bluish colouring and darkness of Mare Acidalium in April, 1920, but marked weakening of appearance in July. Hyperboreus Lacus, north of the former sea which was so visible at the end of April, is also very dark.

The two Nilokeras are strongly visible.

Very good visibility of the canal that goes from the Stymphalius Lacus to the north of the Cydnus.

Reddish brown colouring of Chrysis.

Very marked intensity of the Nepenthes, the Thoth and the Casius, that are beautifully curved.

Very marked appearance of the Coloe Palus, the Boreosyrtis and the Copais Lacus, forming a very large dark spot to the north of the Nilosyrtis.

Rapid developing of the Amenthes from the 24th to the 26th of June.

F.H.

SPECTRUM UND BAHN ELEMENTE VON DELTA ORIONIS

(Von A. Hnatek.—*Astr. Nach.*, No. 5090, p. 25.)

Paragraph 3.—The behaviour of the Ca-Lines:

Hartmann has shown the relative stationary character of the K-line in Ca, with an average velocity of +16 km. Hnatek's observations fully confirm this, and furthermore, he finds that the H-line as well as others of the Ca-lines behave similarly.

The displacement or difference of velocity between the centre of mass and the K-line is given as +3.85 km displacement towards the red.

Hnatek suggests the possibility of this displacement as due to the Einstein effect. On this assumption he deduces the total mass m_1+m_2 of the system of Delta Orionis as $70.7\odot$. From the elements of the orbit we have $m_2^3 \sin^3 i (m_1+m_2)^2 = .613\odot$.

Assuming different probable values for $n = m_1/m_2$ we derive i, and hence the real size of the orbit.

Hnatek investigates Stebbins' light curve of Delta Orionis, which shows that i is greater than 62°.6 and less than 77°.2, from which rather narrower limits are found for n. The absolute magnitude is obtained from the surface brightness, the absolute magnitude of the sun being taken at 5.5. Knowing the apparent magnitude, we find from the relation $M = m + 5 + 5 \log \pi$, the parallax. The limits of the density are taken as 0.1 and 0.006, which correspond to $M - 1.76$ and -4.98, and for π, $''.014$ and $''.003$.

Hnatek's assumptions are very ingenious, and it remains to be seen whether they will hold for stars of which the above quantities, such as parallax, size, and inclination of orbit could be determined by other methods.

O. K.

THE PARALLAXES OF 1646 STARS DERIVED BY THE SPECTROSCOPIC METHOD

(By Adams, Joy, Strömberg and Burwell in the *Ap. Jour.*, *53*, pp. 13-94, Jan. 1921.)

Five years ago, when Adams announced a new method of determining the distance of a star by means of the character of its spectrum lines, there was more or less sceptism as to its reliability. Since then the parallaxes of many stars have been obtained by both methods and their agreement has been so close that the underlying principles of the new method are felt to be sound and the method itself is now on secure footing. A brief description of it is in order. For all stars whose parallaxes were well determined by the old trigonometric method Adams calculated the absolute luminosities, that is, the luminosities the stars would have if all placed at a standard distance corresponding to a parallax of $0''.1$. The absolute luminosities, then, simply represent the actual relative brightnesses of the stars. Examining them by types he found that the intensities of certain lines in the spectra varied according to the actual luminosity of the star. He was thus able to plot empirical curves for each type, correlating the intensities of these lines with the actual brightness of the star. Thus by examining the spectrum of a star he was able to assign to it a certain absolute brightness and then, knowing its apparent brightness, a simple calculation gave its distance.

Since September, 1917, when Adams and Joy issued their first catalogue of 500 such parallaxes, extensive lists of directly measured parallaxes have been published by various observatories and the extra material thus available makes it possible to divide the stars into smaller groups by spectral type with a corresponding greater accuracy in the reduction curves. In the provisional reduction tables for this investigation all available trigonometric parallaxes for stars in the list were used but in the final tables almost exclusive use is made of the lists from Allgheny, McCormick, Yerkes and Mt. Wilson, equal weights being assigned to each. But the authors do not depend entirely upon trigonometric parallaxes for standardizing their curves. In the case of Cepheids and stars of similar type

they find it better to use distances determined from parallactic motion. This method is also used as a check upon groups of the very distant stars, while in the case of the giant M stars a combination of the results from trigonometric determinations and peculiar motions is employed. Formulae are given for all cases.

As a first step in the procedure the type has to be carefully determined. Six typical spectra, of types F0, F5, G0, G5, K0 and K5, according to the Harvard classification, can be matched quickly on the Hartmann spectrocomparator with the spectrum under review and its type "estimated" by interpolation. Also, estimates are made of the relative intensities of the hydrogen lines as compared with other nearby lines and with the aid of a reduction table based upon standard spectra the "measured" type of spectrum is obtained. Then the lines which are found to change rapidly with absolute magnitude are next examined, comparison being made with nearby ones of constant intensity and the relative values recorded. For example, in an F8 type spectum the strontium line w.l. 4077 increases in intensity relative to the iron line at w.l. 4072 by over 5 whole steps on Adams' scale as the absolute magnitude changes from $+3.0$ to -2.0.

This catalogue of 1646 stars includes the 500 previously determined for which revised values are given. It is felt that although future series of directly determined parallaxes will necessarily make changes, yet they will be small and the corrections can be applied in the form of tabular modifications of these results. The absolute magnitudes and parallaxes here obtained are found to have probable errors of ± 0.4 magnitude and 20 per cent. respectively.

W. E. H.

A Photo-Electric Study of Algol (by Joel Stebbins, *Ap. J.*, *53*, p. 105).

This investigation was made for the purpose of confirming and strenghtening the one made ten years earlier by the selenium photometer and to find if any rotation of the line of apsides could be detected. However, little change in the orbit was found and the photometric evidence all points to a circular orbit. Small corrections to phase computed from Hellerich's orbit were determined and it is suggested that observations be made every year or two to check up this change. It is stated that the definitive value for the elements cannot be found until measures of the spectrum and magnitude of the third body, which has a period of 1.9 years, and a very accurate parallax for Algol, are available. The striking feature about this investigation is the remarkable accuracy of the measurements of brightness obtained by the photo-electric cell. The probable error of one normal place at primary minimum is 0.007 of a magnitude and at secondary and between minima 0.004 and the relative weight of the determination is four times that given by the selenium photometer. It was shown that one of the comparison stars, Delta Persei, used with the selenium photometer, probably is variable over a range of 0.04 or 0.05 magnitude.

J. S. P.

The Orbit of the Short Period Spectroscopic Binary 65 Tau Cygni (by J. S. Paraskévopoulos, *Ap. J.*, *53*, p. 144).

This is a very interesting triple system consisting of a 3.8 magnitude star with an 8.0 magnitude component forming a visual binary with a period of 47 years. The bright star was found by Barrett to be a spectroscopic binary and the author has investigated it and found it to have the shortest period known 3h 25.4m. The projected semi-axis major $a \sin i$ is less than 15,000 km. With the best-determined parallax $0''.03$ the author computes the diameter of the bright star to be nearly 9,000,000 km, but this should probably be reduced, as he assumed its surface brightness, spectral type F0, the same as the sun. Using reasonable assumptions he shows that the distance between the centres of the bright star and its spectroscopic companion must be considerably less than the radius of the bright star. He attempts to explain this anomaly on the hypothesis of a pear-shaped body or of a single pulsating body, but neither hypothesis appears to be tenable. J. S. P.

THE COLOUR OF THE LIGHT FROM THE NIGHT SKY

(Lord Rayleigh, *Proceedings Royal Society*, *A 99*, 10, 1921)

This paper contains an account of an investigation to determine the colour of the night sky and a comparison of its colour with that of other sources. On account of the feeble light a spectroscope was not used. A series of seven coloured filters giving transmissions ranging from 0.33 μ to 0.70 μ were mounted in a frame which held in addition a neutral tint wedge graduated according to Hurter and Driffield's method. This frame, with an Ilford Penchromatic Plate, could be exposed to any light source. The plates were measured by comparing the density of a patch under a given filter with a patch of like density under some portion of the wedge. The measurement was performed by means of a photo-electric cell—a device previously used by Rayleigh in his experiments on scattered light, and which he finds more sensitive than visual methods.

The result, which he confirms by a visual test, is that the colour of the night sky is the same as that of sunlight or moonlight, but is consequently much more yellow than the day sky. This has an obvious bearing on the theory of the light of the night sky. It is clearly not sunlight scattered by a rare gaseous atmosphere so high up as to be clear of the earth's shadow. The absence of polarization leads to the same conclusion. Sky light may either be regarded as light coming from the unresolved background of the stars, or as sunlight scattered by meteoric matter. The latter conclusion is more likely since in the former case the night sky light would be probably more bluish than sunlight. H. H. P.

THE VACUUM ARC SPECTRA OF SODIUM AND POTASSIUM

(S. Datta, *Proceedings Royal Society*, *A 99*, 69, 1921)

This is an investigation performed at the Imperial College of Science under the direction of Professor A. Fowler. There has long been a need for more ac-

curate measures of the lines in the spectral series of the alkali metals. Advantage was taken of the fact that the "sodium vapour lamp" recently used by Lord Rayleigh for work on fluorescent spectra gave narrow sharp lines for members of the diffuse series. This same lamp was used, and the spectra were made in the first and second orders of the 10-foot concave grating. Burns' iron lines were used as standards.

For sodium he obtains very accurate measures of D_1 and D_2, the first members of the principal series, measures of 6 pairs of the sharp series for which he gives a Hick's formula, and measures of 5 pairs of the diffuse series. He also notes and gives approximate wave-lengths for a new band spectrum in sodium. For potassium similar measures are given. He finds in connection with the combination terms involving the second principal pair that the reason for previous discrepancies noted by Paschen are due to unsymmetrical broadening of these lines.

In comparison with the solar spectrum he is able to suggest several new identifications the most important of which is the first pair of principal lines, w.l. 7699.01 and w.l. 7664.94, which establishes definitely the presence of potassium in the sun. H. H. P.

ON SPECTROPHOTOMETRY IN THE VISIBLE AND ULTRA-VIOLET SPECTRUM

(T. R. Merton, *Proceedings Royal Society, A 99*, 78 ,1921)

This paper contains an account of a new and ingenious method of spectrophotometry which has interesting applications in laboratory and astronomical investigations.

1. *Method.*—Between the prism and the camera lens of the spectrograph is placed a coarse grating (25 lines to the inch) with its rulings perpendicular to the prism edge. The slit is limited in length. The result on the photographic plate is that the spectrum is spread into a number of narrow bands which are the first, second, third, etc., order spectra of the grating. The brightness of these spectra follows from the Rayleigh formula, but Merton finds it necessary to calibrate his grating. For this purpose he uses the wedge method at various wave lengths. From this data, given in curves, the relative photographic intensities in a spectrum can be determined for the wave lengths at which the various spectral orders just tail off—the actual points being determined presumably by process screen enlargements. The photographic intensities, thus determined, can be made absolute by a spectrum of a source of known intensity distribution—such as the positive crater of the carbon arc.

2. *Laboratory Applications.*—There are two advantages which this grating method has in laboratory investigations over the wedge method, as improved by Merton and Nicholson. (*a*) Since the slit is limited in length it permits the examination of the intensity distribution in point sources without the loss of light entailed in spreading the image of such a source out to cover the wedge. (*b*) Intensities can be determined as far into the ultra-violet as quartz or fluorite will transmit with the same apparatus as used for the visual spectrum—a thing difficult, if not impossible, with the wedge method.

3. *Astronomical Investigations.*—The peculiar advantage of the method for astronomical work lies in the fact that it requires only a point image on slit instead of an extended uniform illumination along the slit. Consequently Merton suggests that this grating method may be used with telescopes of moderate aperture with an objective prism and presumably a wire grating. The calibration of such a grating, it may be pointed out, would probably have to be performed by some method of visual spectrophotometry using various monochromatic sources.

For use with a slit spectroscope, however, the method presents no gain but rather a loss in efficiency as compared with the wedge method. With the wedge at present in use at Victoria it is possible to secure a good wedge spectrum with the same exposure time as is required for a spectrum of the same width without wedge. The grating method not only spreads out spectrum to about the same width as wedge spectrum but also, due to the opacity of grating, requires at least four times the exposure of a spectrum of same width taken without the grating. Briefly put, the grating method requires at least four times the exposure time used by the wedge method. The grating method is open to a second objection owing to the fact that it is essentially a discontinuous method. Accordingly it is only possible to measure the intensities at points where the various orders happen to end. But in late type spectra, where strips of continuous spectra free from absorption lines are only a few angstroms wide, and are scattered throughout the spectrum, it is essential to be able to measure intensities at specified wave lengths. This, of course, can be done with the wedge method but with the grating method it is largely a matter of chance.

Notwithstanding these objections, it is evident that the grating method applied to the objective prism will serve as a new and powerful method of astronomical research, and will throw much light on the important question of intensity distribution in stellar spectra. The reviewer understands that an astronomical application of the method is about to be applied at Cambrdige by F. J. M. Stratton. His results will be awaited with much interest.

H. H. P.

DAILY WOBBLING OF THE EARTH'S POLE

(*Ast. Nach.* No. 5102. "Neuer Beitrag zur Frage der täglichen Polhöhenschwankung".)

Dr. L. Courvoisier reviews G. Boccardi's "Recherches faites a l'Observatoire de Pino Torinese sur une variation diurne de la latitude en 1919-1920", and concludes by saying that the recent observations of Boccardi confirm the former conclusion arrived at through the investigations and observations made by Kimura, Wanach and himself that there is no regular oscillation of the polar distance coincident with a mean solar day.

O. K.

MOTION IN THE SPIRAL NEBULA IN TRIANGULUM

(*Internal Motion in the Spiral Nebula Messier 33.* Preliminary Results. Adriaan van Maanen, *Proceedings of the National Academy of Sciences*, 7, 1-5, 1921.)

After referring to the analogous results obtained by himself for Messier 101, and by Lampland and Kostinsky for Messier 51, from plates taken at intervals of from 5 to 20 years, the author gives his results for the measures of Messier 33 from two pairs of plates taken with the 60-inch Mount Wilson reflector at the 25-foot focus (1910 and 1920) and at the 80-foot focus (1915 and 1920). The measures seem to indicate a motion outward along the arms of the spiral, and when these are resolved into radial and tangential motions and compared with the spectroscopic measurements of the velocity of rotation made by Pease in 1916, it would appear that the parallax of the spiral is about $0''.0005$, and its diameter about 100 light-years, the absolute magnitudes of the individual points being $+1$ and fainter. On the other hand, if the spiral be of the magnitude of the galactic system its distance would be several million light-years and the motions as measured would be of the order of the velocity of light. "The internal motions in the spirals seem now to be well founded, and if time justifies this belief, they will accordingly afford a most important argument against the view that these nebulae are systems comparable with our galaxy". (Note by abstractor,—In view of the serious distortions which photographic images undergo, depending on the development, fixing, washing and drying revealed by the recent work of Ross, it would seem to be essential that plates compared over a range of years should, as far as possible, be identical in kind and treatment. In the comparisons of images of spiral nebulae it might be expected that there would be different distortions along and at right angles to the arms of the spiral depending on the treatment). R. E. De L.

NOTES AND QUERIES

Communications are Invited, Especially from Amateurs. The Editor will try to Secure Answers to Queries

DR. SATTERLY'S PAPER ON "THE HATCHET PLANIMETER"

Inadvertently Dr. John Satterly's name was not given as the author of the paper on "The Hatchet Planimeter" in the last issue of the JOURNAL. Also there should have been added a note stating that the paper was reprinted from the *University of Toronto Studies*, by kind permission of Mr. H. H. Langton, the editor of the *Studies*, and with the approval of Dr. Satterly, the author of the paper.

BURNHAM'S LIFE AND WORK

In the present issue appears an authoritative and excellent sketch of the remarkable work of the late S. W. Burnham, written by Professor Frost, which all will be pleased to read. Attention may also be directed to a charming sketch of Burnham in *Popular Astronomy* for June-July. Its author is Professor E. E. Barnard, who recounts many intimate personal incidents in their long comradeship. They give a close-up view of their subject which every one will appreciate. The references to the life on Mount Hamilton will be found interesting to all, but especially so to those who have spent some time at the Lick Observatory, in the history of which Burnham and Barnard will always have a prominent place.

"LATINO SINE FLEXIONE"

From Professor James Weir, of McGill University, has been received a portion of Circular No. 10 of the Observatory of Cracow, Poland, together with a translation of it and of another portion of the publication. These are given below. The circular is written in the "interlingua" known as "Latino sine Flexione," invented by

Professor Peano, of Turin, after the ideas of Leibniz. Professor Weir remarks that any one with a slight knowledge of Latin can readily gather the meaning of the sentences. This is fairly evident from the sample given.

CIRCULARE DE OBSERVATORIO DE CRACOVIA, No. 10

"Schedula in Nautical Almanac 1923 annota, que, ab anno 1925, horas designato "Greenwich Medio Tempore" i es computato ab medionocte. Magno confusione appare to immine in consequentia de ce denominatione, nam "Gr. M. Temp." es scientifico termino technico. An non esbi plus simplice to designa "Greenwich Tempore Civile" tempore, computato in horas medio ab medionocte de Greenwich?"

Translation:

A note in the Nautical Almanac of 1923 states that dating from the year 1925 the hours designated G.M.T. are computed from midnight. Great confusion appears imminent in consequence of this terminology for G.M.T. is a technical scientific term. Would it not be simpler to designate as "Greenwich Civil Time" the time computed in mean hours from Greenwich midnight?

Translation:

Our colleagues, whose mother tongue is at the same time a world tongue, may be inclined to consider the use of this "Latino sine flexione" as a harmless oddity. We beg them to reflect solely that long and patient study—rarely successful, but always consuming much precious time of man's brief span of life—is needed to write correctly a language not our own, for no living tongue has grammatical regularity and merely, concerning this interlingua "that it is well written if it is easily intelligible to the reader." Frequently, moreover, foreign writers, wishing to express themselves in English, French, German or Italian, use in reality simply a species of volapük, offending the eye of, or appearing ridiculous to, the reader.

"Latino sine flexione" is a language composed of Latin words, without grammatical inflections; it possesses an ample vocabulary common to Latin—Italian—French—English—German; it embodies about 14,000 words (Cavoretto-Torino, 1915, ed. II., price 8 fr.) and was composed by the illustrious mathematician, Professor Giuseppe Peano.

A BRILLIANT DAYLIGHT METEOR

At about 5.30 p.m. on Saturday, July 16, 1921, a brilliant fireball was seen in full daylight at Go Home Bay, Ont. This place is on the east side of the Georgian Bay, in Long. 79°57′W. and Lat. 45°N., and numerous summer cottages are located there, among them being that of Dr. L. F. Barker, of Baltimore, Md.,

who has kindly furnished me with the following brief descriptions of the phenomenon by Miss Barker and Mrs. Stewart Paton (of Princeton, N.J.). Dr. Barker did not see the body himself but heard the hissing noise made by it.

Attracted by a hissing sound I looked from the boat to the sky and saw an incandescent ball, tending out behind to cone-shape, plunging in the direction of the arrow [from east to west and downwards at about 45° with the vertical]. It fell rapidly and was soon behind the post office building and appeared to be landing at a point almost due north.

The size of the meteor seemed to me about that of a small moon. The incandescence made it look like a small sun, but it did not affect my eyes as sunlight would have done.

GRACE S. T. BARKER.

I was seated in a small boat tied to the wharf at Go Home landing, when suddenly I was attracted by a hissing sound in the air, such as is made by a rocket. Quickly looking up I saw an incandescent pear-shaped mass, with a short spirally-formed tail, shoot downward through the air at an angle and height that suggested it might fall into the bay between the wharf and the Wishart House [one-fifth of a mile away], or into the woods back of the house.

The size of the mass is difficult to estimate as it was too far above the trees and wharf for them to be used as a means of comparison, but my impression is that in appearance it approximated the size of the moon when seen in the daytime. Aside from the extraordinary brilliancy of the incandescent mass I was struck by a feeling of great heat—the colour was redder towards the centre than at the edges, and, also, I distinctly sensed a rotary motion, the short tail being spirally twisted.

F. M. PATON.

THE ELEMENTS OF MAP PROJECTION

The United States Coast and Geodetic Survey has recently published a work entitled "Elements of Map Projection with Applications to Map and Chart Construction," by Charles H. Deetz and Oscar S. Adams, of the staff of the Survey. This is a result of problems encountered during the recent war and as a consequence the treatment of the subject embodies the very latest researches, while it omits certain methods which are little more than geometrical exericses with no useful practical application.

Part I. (pages 7 to 52) discusses in an elementary way the various methods of representing a sphere on a flat surface. Part II. (pages 53 to 145) treats in considerable detail the polyconic,

Bonne, Lambert equal-area, Lambert conformal, grid, Albert, Mercator and gnomonic projections. There are 74 figures and 8 folding plates, which illustrate the text in a clear and simple manner. The work is certainly a valuable contribution to the subject of map construction. The volume can be obtained from the Superintendent of Documents, Washington, at the nominal price of fifty cents.

I have long wondered why the *ecliptic* was marked on terrestrial globes, also why so much detail is often given, and so was interested to read the following remarks on page 20:

> However, before globes come into more general use it will be necessary for makers to omit the line of the ecliptic, which only leads to confusion for old and young when found upon a terrestrial globe. It was probably copied upon a terrestrial globe from a celestial globe at some date by an ignorant workman, and for some inexplicable reason it has been allowed to remain ever since. However, there are some globes on the market to-day which omit this anomalous line.
>
> Makers of globes would confer a benefit upon future generations if they would make cheap globes on which is shown, not as much as possible, but essential geographic features only. If the oceans were shown by a light blue tint and the continents by darker tints of another colour, and if the principal great rivers and mountain chains were shown, it would be sufficient. The names of oceans and countries, and a few great cities, noted capes, etc., are all that should appear. The globe then would serve as the index to the maps of continents, which again would serve as indexes to the maps of countries. Globes as made at present are so full of detail, and are so mounted, that they are puzzling to any one who does not understand the subject well enough to do without them, and are in most cases hindrances as much as helpers to instruction.

ASTRONOMIC WIRELESS AND OTHER

At Fort Providence, in the wilds of the Mackenzie Basin, were three Dominion Observatory astronomers recently observing for geographic positions in connection with oil discoveries. The longitude work is necessarily by wireless, receiving signals from Annapolis, San Diego and San Francisco, the same signals being recorded also at the Dominion Observatory, Ottawa. By comparisons later the longitude of the Mackenzie station is found.

The wireless expert and astronomer, J. P. Henderson, caught the wireless message announcing the result of the encounter

between Dempsey and Carpentier, showing the latter to be an eclipsing variable, radial velocity in line of sight 120 km. a second, period 12 minutes for 4 revolutions.

The news was had at Fort Providence as soon as elsewhere, and spread up and down the Mackenzie to the consternation of natives and others, as this is the only wireless outfit in these boreal regions.

O. K.

FRIENDSHIP

To T. H. R., by Walter Garstang in *Nature*

Were life an empty bubble blown by chance
To glitter, mount, and burst beyond repair;
Were mind delusion, fancies rich and rare
Mere exhalations, firefly effluence;

Or should this mood be but the spirits' trance,
And one enduring Whole his being share
By ordered gradients up the thronal stair
From atom-fires to soulful radiance;

Be all philosophy beyond our ken,
And nothing certain—yet, as star draws star,
As bubbles meet and cling, electrons blend,
There sings a joy when friend meets parted friend,
Time's limitations yield, and, past the bar,
Life's transcendental portals ope again.

AN ASTRONOMICAL EXHIBIT

Perhaps the best known annual event in Toronto is the Canadian National Exhibition, which is held during two weeks, beginning near the end of August. From a comparatively small beginning about fifty years ago it has grown into the world's largest annual exhibition, with more than a million admissions. This year the University of Toronto was asked to make a display of its activities, the object being to acquaint visitors with what the Provincial

University is attempting to do, especially for the people of Ontario and for Canada in general. Along with the other departments, that of Astronomy was asked to take part, and though the time was rather short its exhibit was very successful.

Through the cordial co-operation of the Warner and Swasey Co. of Cleveland two splendid features were added. One was a model of the great 72-inch reflecting telescope and the dome of the Dominion Astrophysical Observatory at Victoria, B.C. This was constructed by the firm in order to assist them in working out the very complicated details of the great instrument. It stands about nine feet high and though of aluminium it weighs nearly two tons. It shows clearly the arrangement of the moving platform and the ladders by which the upper end of the telescope can be reached when it is in any position. This model has been presented by the Warner & Swasey Co. to the Dominion Government.

The other special feature was a complete nine-inch refracting telescope. In the projected astronomical observatory for Toronto it is proposed to have a telescope of about this size continually at the service of the people.

In addition to the above there were smaller telescopes, celestial spheres, a model of the moon (by Collier), beautiful transparencies of nebulae and other celestial objects, photographs of the Ottawa and Victoria observatories and of various astronomical objects, all plainly labelled.

The exhibit attracted great numbers of visitors and undoubtedly created interest in the general work of the University and in astronomy in particular. C. A. C.

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